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(54) Title: DEINKING PROCESS

(57) Abstract

To provide a deinking process according to which bulkier pulp sheets excellent in paper strength, printability, etc. can be obtained. In a deinking process at least comprising the step of stripping ink from wastepapers as the starting material and the step of removing the stripped ink from a flotation system, the flotation step is controlled so that the interfacial potential (ξ potential) of the ink particles is in the range of -5 mV to -60 mV and the interfacial potential (ξ potential) of pulp is in the range of -15 mV to +15 mV with a difference of at least 10 mV in the ξ potential therebetween.

Description

DEINKING PROCESS

Background of Invention

Field of the Invention

The present invention relates to a deinking
method for deinking wastepapers such as newspapers,
leaflets and magazines to reclaim them. More
particularly, the present invention relates to a
deinking process according to which bulkier pulp
sheets can be obtained.

Prior Arts

Wastepapers are reclaimed by stripping ink from
the wastepapers by a deinking treatment to prepare
reclaimed pulp and manufacturing reclaimed paper
from the reclaimed pulp. The conventional deinking
methods generally comprises a step of stripping ink
from wastepapers and a step of discharging the
stripped ink.

More specifically, the deinking method
comprises as main steps:

(1) a step of pulping (disintegrating) wastepapers,

(2) a step of aging, i.e., leaving the
disintegrated paper as it is,

(3) a step of flotation, and

(4) a step of washing.

That is, in deinking treatment, ink bound to the fibers of wastepapers is physically and chemically (or biochemically) stripped therefrom to thereby separate the ink from the fibers. Thus, reclaimed pulp is obtained.

The foregoing ink stripping in the conventional deinking treatment is generally carried out at a high pH (pH: 10 to 9), followed by the removal of the ink under the same conditions in the flotation step.

In recent years, the properties of wastepapers which are used as the starting material have been varied because of an increase in a demand for a beautiful and stable printing and a progress in printing techniques. Besides, the degree of bond of ink to paper is widely varied from a mild to strong one. Under these circumstances, it is demanded to improve the quality and the recovery (i.e., productivity) of deinked pulp. In order to attain these purposes, various proposals are offered from various field including deinking processes, deinking agents and apparatuses used for deinking.

However, most of the techniques heretofore proposed are directed to an improvement in the whiteness of deinked pulp. Thus, it cannot be said that sufficient investigations have been made on the strength and bulk density of pulp sheets. Although

the pulping step and the flotation step in the
conventional deinking method are generally carried
out at a pH value on the alkaline side such as a pH
of 10 to 9 as described hereinbefore, it cannot be
said that the paper strength and bulk density of
the resulting pulp sheets are satisfactory.
Although there are known some deinking methods
wherein the pulping step and the flotation step are
carried out at a pH of at most 9 (JP-A 54-23705, JP-
A 59-53532 and US-A 4043908), these methods are not
necessarily effective as measures for improving the
strength and bulk density of pulp sheets.

Disclosure of the Invention

Summary of Invention

As a result of detailed investigations on the
removal of ink by flotation, the inventors of the
present invention have found out that the
interfacial potentials of ink and pulp in the
flotation step exert great influences on the bulk
density of pulp sheets. The present invention has
been completed based on this finding.

The present invention provides a deinking
process comprising at least the step of stripping
ink from a pulp slurry formed from wastepaper as the
starting material, wherein at least one surfactant
is used for ink stripping, and the step of removing
the stripped ink by flotation, characterized by

controlling before or in the flotation step the
interfacial potential (ζ potential) of ink particles
in said pulp slurry containing the stripped ink to
be in the range of -5 mV to -60 mV and that of pulp
in said pulp slurry containing the stripped ink to
be in the range of -15 mV to +15 mV with a
difference of at least 10 mV between the interfacial
potential (ζ potential) of said ink particles and
said pulp. The adjustment of the ζ potential may be
conducted before or in the flotation step. It may be
conducted during or at least at a point in time of
the flotation step.

The present invention further provides a method
for controlling the deinking performance in a
deinking process comprising at least the step of
stripping ink from a pulp slurry formed from
wastepaper as the starting material, and the step of
removing the stripped ink by flotation,
characterized by measuring before or in the
flotation step the interfacial potential (ζ
potential) of ink particles and pulp in said pulp
slurry containing the stripped ink and adjusting the
interfacial potential (ζ potential) of the ink
particles to the range of -5 mV to -60 mV and the
interfacial potential (ζ potential) of pulp to -15
mV to +15 mV with a difference of at least 10 mV in
interfacial potential (ζ potential) between said ink

particles and said pulp.

Thus the present invention provides a deinking process at least comprising the step of stripping ink from wastepaper as the starting material and the step of removing the stripped ink by the flotation method, characterized by using at least one surfactant for ink stripping and controlling in the flotation step the interfacial potential as the ζ potential of ink particles to be in the range of -5 mV to -60 mV and that of pulp to be in the range of -15 mV to +15 mV with a difference of at least 10 mV in interfacial potential as the ζ potential between the ink particles and the pulp.

In the present invention, the step of stripping ink from wastepapers as the starting material is carried out by appropriately cutting wastepapers as the starting material, adding warm water and various chemicals such as an alkaline agent thereto, adding a surfactant as a deinking agent to the resulting pulp slurry, and mechanically agitating the slurry. Subsequently, the pulp slurry containing the stripped ink is fed into a flotator to carry out flotation step. In the present invention, the interfacial potential (ζ potential) of ink particles in the flotation step is controlled to be in the range of -5 mV to -60 mV, preferably -10 mV to -40 mV, further preferably -20 mV to -30 mV. On the

other hand, the interfacial potential (ζ potential)
of pulp in the flotation step is controlled to be in
the range of -15 mV to +15 mV, preferably -5 mV to
+5 mV, further preferably -5 mV to 0 mV. Further, a
difference in ζ potential between both is controlled
to be at least 10 mV, preferably at least 15 mV,
further preferably at least 20 mV. It will suffice
when the ζ potentials are adjusted before, during or
at least at a point in time of the flotation step
and are measured preferably immediately before the
start of the flotation step. In so far as these
values are in the above-mentioned ranges, the
interfacial potentials may be fluctuated in the
flotation step (for example, by the addition of
cationic compounds as will be mentioned later, or by
other means). However, it is preferred that the
above-specified interfacial potentials be satisfied
in the flotation step as well. Also it is
permissible to examine a method of controlling the ζ
potentials to be in the above-specified ranges in
the flotation step separately on a laboratory scale
and apply this method to the operation on a real
equipment level in factories or the like. In this
case, the ζ potential control method found out
preliminarily may be applied to the operation of
real equipment.

The interfacial potentials (ζ potentials) of ink

and pulp can be controlled by, for example, varying
the pH of the system (i.e., water being treated) in
the flotation step or adding an inorganic
electrolyte to the system in the flotation step.
The potentials are preferably controlled by varying
the pH. Specifically, such control is carried out
by controlling the pH of the system in the flotation
step to be between around neutrality and a weak
acidity. The pH is adjusted by adding acids such as
hydrochloric or sulfuric acid. In the case of
adding an inorganic electrolyte, salts such as
calcium chloride, magnesium chloride, potassium
chloride, sodium chloride, calcium sulfate,
magnesium sulfate, potassium sulfate, sodium
sulfate, and aluminum sulfate are added in such a
way as to provide the desired ζ potentials.

In the present invention, the ζ potentials of
ink particles and pulp can be measured with a ζ
potential measuring instrument. The numerical value
of the ζ potential is somewhat varied depending on
the method of measurement. In the present
invention, the measurement is made by the
electrophoretic method using System 3000
manufactured by Pen Kem Co.. Since the pulp slurry
has too high a concentration for the ζ potential
measurement, a suitable amount of a slurry sample is
added to a 0.005 M solution of potassium chloride.

More specifically, the pulp slurry in the flotation step is diluted as such for use as a pulp sample in the ζ potential measurement with the above-mentioned measuring instrument, while the filtrate obtained by the filtration of the pulp slurry in the flotation step through a 120-mesh or 200-mesh sieve is diluted for use as an ink sample in the ζ potential measurement with the above-mentioned measuring instrument. The ζ potential of pulp is measurable by using the pulp slurry in the flotation step as such in the measurement. By contrast, in the case of the ζ potential measurement of ink, since the amount of ink is small as compared with that of pulp, filtration with a finer-mesh sieve is necessary when the amount of fine fibers is extremely large. On the other hand, when satisfactory separation is impossible by filtration, the ζ potential of ink can be calculated by subtracting the electric charge distribution of pulp from the electric charge distribution of ink-pulp. The System 3000 manufactured by Pen Kem Co. is capable of measuring electric charge distribution as well.

Although the reason why bulkier pulp sheets can be obtained by adjusting the interfacial potentials of ink particles and pulp in the flotation step as described above has not necessarily been elucidated,

the following reason may be conceivable by way of
example. The control of the ζ potentials to be in
the aforementioned ranges leads to reduced electric
charges on pulp to minimize the electrostatic
repulsion. According to conventional deinking
methods, floating fine fibers are removed either
together with ink in the course of flotation or in
the washing step. By contrast, it is believed that
the electrostatic repulsion is minimized by the ζ
potential control according to the present invention
to enable fine fibers to be adsorbed on longer
fibers and hence retained in the system without
causing outflow thereof to thereby maintain a given
interfiber distance, whereby the density of pulp is
decreased to lower the density of the resulting pulp
sheet.

   According to another embodiment of the present
invention, there is provided a deinking process at
least comprising the step of stripping ink from
wastepaper as the starting material and the step of
removing the stripped ink by the flotation method,
characterized by using at least one surfactant for
ink stripping and effecting the flotation step after
controlling the interfacial potential as the ζ
potential of ink particles in a pulp slurry
containing the stripped ink to be in the range of -5
mV to -60 mV and that of pulp to be in the range of

-15 mV to +15 mV with a difference of at least 10 mV
in interfacial potential as the ζ potential between
the ink particles and the pulp.

As a result of further detailed investigations
on the interfacial potentials and the deinking
performance in the flotation step on the basis of
the foregoing finding, the inventors of the present
invention have found out that there is a correlation
between the interfacial potentials of ink particles
and pulp and the results of deinking (the bulk
density of the pulp sheet in particular) in the
flotation step. Specifically, in an arbitrary
deinking process including the flotation step, when
the desired results are obtained, the interfacial
potentials of ink and pulp are measured to select
suitable ranges of the interfacial potentials in the
system, the final results of deinking can be
estimated only by observing whether or not the
interfacial potentials in the system fall within
these suitable ranges. In other words, it can be
judged that the results of deinking obtained by this
deinking treatment can be excellent when, for
example, the interfacial potentials (ζ potentials)
of ink particles and pulp in the flotation step are
-5 mV to -60 mV and -15 mV to +15 mV, respectively,
with a difference of at least 10 mV in interfacial
potential as the ζ potential between the ink

10

particles and the pulp as described above. When the
interfacial potentials of the ink particles and the
pulp are outside these ranges to the contrary, it
may be estimated that the results of deinking are
poor. This method of the present invention for
estimating the results of deinking from the
interfacial potentials of ink particles and pulp in
the flotation step is so highly reliable that it
becomes an effective means for controlling the
deinking treatment in the operation of real
equipment.

Accordingly, the present invention provides a
deinking process at least comprising the step of
stripping ink from wastepaper as the starting
material and the step of removing the stripped ink
by the flotation method, characterized by continuing
the deinking treatment when the interfacial
potential as the ζ potential of ink particles is in
the range of -5mV to -60 mV and that of pulp is in
the range of -15 mV to +15 mV with a difference of
at least 10 mV in interfacial potential as the ζ
potential between the ink particles and the pulp as
a result of measurement of the interfacial
potentials of the ink particles and the pulp in the
flotation step. The present invention also provides
a deinking process comprising at least the step of
stripping ink from wastepaper as the starting

material and the step of removing the stripped ink

by the flotation method, determining interfacial

potentials of the ink particles and the pulp in the

flotation step, then estimating the deinking

performance by determining a ζ potential of the ink

particles, that of pulp, and the difference in ζ

potential between the ink particles and the pulp.

Detailed Description of the Invention

In the deinking process of the present

invention, at least one surfactant is used for ink

stripping. As the surfactant, there can be used

those known as conventional deinking agents,

preferably cationic surfactants, anionic

surfactants, and nonionic surfactants, among which

nonionic surfactants are especially preferred. The

use of at least one member selected from among the

following nonionic surfactants (A) to (D) is

preferred. The following nonionic surfactants (A),

(B) and (C) are especially preferred, among which

the following nonionic surfactant (C) is further

preferred.

<Nonionic surfactant (A): A reaction product

obtained by adding an alkylene oxide to a mixture of

an oil & fat and an alcohol>

A nonionic surfactant (A) is an alkylene oxide

adduct of a mixture of an oil & fat and a mono- or

polyhydric alcohol. The alkylene oxide is added to

12

the mixture described above in an amount, on the
average, of 5 to 300 moles, preferably 20 to 150
moles, per mole of the mixture. Examples of the
alkylene oxide include ethylene oxide, propylene
oxide, and butylene oxide, which may be used alone
or in the form of a mixture of two or more of them.

The mixing ratio of the oil & fat to the
alcohol is preferably 1/0.1 to 1/6, particularly
preferably 1/0.3 to 1/3. When this ratio falls with
in the above-mentioned range, a reclaimed pulp
having an excellent appearance can be obtained since
the ink stripping is efficiently attained.

Examples of the oils & fats as a starting
material of the nonionic surfactant (A) include
vegetable oils such as coconut oil, palm oil, olive
oil, soybean oil, rape seed oil, and linseed oil;
animal oils such as lard, beef tallow, and bone oil;
and fish oils; hardened oils and semihardened oils
thereof; and recovered oils obtained in refining
processes of these oils & fats. Especially
preferred are coconut oil, palm oil, and beef
tallow.

Examples of the monohydric alcohol as a
starting material of the nonionic surfactant (A)
include those having an alkyl or alkenyl moiety of 8
to 24 carbon atoms, and those having an alkylphenyl
moiety wherein the alkyl moiety has 6 to 14 carbon

13

atoms. Those having an alkyl moiety of 12 to 18

carbon atoms are preferred. Specific examples

thereof include 1-octanol, 1-nonanol, 1-decanol,

1-undecanol, 1-dodecanol, 1-tridecanol,

1-tetradecanol, 1-pentadecanol, 1-hexadecanol,

1-heptadecanol, 1-octadecanol, 1-nonadecanol,

1-eicosanol, 1-heneicosanol, 1-docosanol,

1-tricosanol, 1-tetracosanol, 2-octanol, 2-nonanol,

2-decanol, 2-undecanol, 2-dodecanol, 2-tridecanol,

2-tetradecanol, 2-pentadecanol, 2-hexadecanol,

2-heptadecanol, 2-octadecanol, 2-nonadecanol,

2-eicosanol, 2-octen-1-ol, 2-dodecen-1-ol,

2-undecen-1-ol, 2-tetradecen-1-ol,

2-pentadecen-1-ol, 2-hexadecen-1-ol,

2-octadecen-1-ol, 8-nonen-1-ol, 10-undecen-1-ol,

11-dodecen-1-ol, 12-tridecen-1-ol,

15-hexadecen-1-ol, oleyl alcohol, elaidyl alcohol,

linoleyl alcohol, linolenyl alcohol, eleostearyl

alcohol, ricinoyl alcohol, cyclononanol,

cyclodecanol, cycloundecanol, cyclododecanol,

cyclotridecanol, cyclotetradecanol,

cyclopentadecanol, cyclohexadecanol,

cycloheptadecanol, cyclooctadecanol,

cyclononadecanol, cycloeicosanol, octylphenol, and

nonylphenol.

Examples of the polyhydric alcohols as a

starting material of the nonionic surfactant (A)

include ethylene glycol, propylene glycol,
trimethylene glycol, butylene glycol, 1,6-hexane
glycol, 2-ethylbutane-1,2,3-triol, glycerol,
trimethylolpropane, trimethylolethane, 1,2,4-
butanetriol, 1,2,6-hexanetriol, 1,1,1-
trimethylolhexane, tetramethylolcyclohexanol,
diglycerol, mannitane, pentaerythritol, erythritol,
arabitol, sorbitol, D-glycero-D-galactoheptose,
D-glycero-D-glucoheptose, D-glycero-D-mannoheptose,
D-glycero-L-mannoheptose, D-altroheptulose,
D-mannoheptulose, D-altro-3-heptulose, D-glycero-
D-galaheptitol, D-erythro-D-galaoctitol,
D-glycero-D-mannooctulose, D-erythro-L-glononulose,
cellobiose, maltose, lactose, gentianose,
cellotriose, and stachyose. Preferred are ethylene
glycol, propylene glycol, glycerol, and
trimethylolpropane.

<Nonionic surfactant (B): a compound represented by
the formula: RCOO(AO)$_m$R'>

Wherein R represents an alkyl or alkenyl group
having 7 to 23 carbon atoms; R' represents a
hydrogen atom, an alkyl group having 1 to 22 carbon
atoms, an alkenyl group having 2 to 22 carbon atoms,
or an acyl group having 2 to 22 carbon atoms,
preferably a hydrogen atom; AO represents an
oxyalkylene group having 2 to 4 carbon atoms; and m
is an integer of 1 or more.

When the carbon atom number of the alkyl or
alkenyl group in the definition of R is 7 to 23, the
nonionic surfactant (B) exhibits an excellent ink-
collecting ability and an excellent ink-stripping
ability to thereby provide reclaimed pulp having a
high whiteness and excellent appearance.

When the carbon atom number of the alkyl,
alkenyl or acyl group in the definition of R' is 22
or less, the nonionic surfactant (B) exhibits an
excellent ability for stripping ink from cellulose
to thereby provide reclaimed pulp having an
excellent appearance, and exhibits an appropriate
lathering power to thereby attain an excellent
workability.

The nonionic surfactant (B) is prepared by
adding an alkylene oxide to a fatty acid by a
conventional method, optionally followed by
esterification or acylation. The alkylene oxide is
added to a fatty acid in an amount, on the average,
of 5 to 300 moles, preferably 10 to 150 moles, per
mole of the fatty acid. That is, the nonionic
surfactant (B) is generally a reaction product
mixture comprising compounds each represented by the
above-mentioned formula: $RCOO(AO)_mR'$. Examples of
the alkylene oxide include those mentioned in the
above explanation relating to the nonionic
surfactant (A). It is preferred to use ethylene

16

oxide and propylene oxide in a molar ratio of
ethylene oxide to propylene oxide of 1/5 to 5/1 in
the production of nonionic surfactant (B).

Examples of the fatty acids to be used for
producing the nonionic surfactant (B) include those
having an alkyl or alkenyl moiety, corresponding to
R, of 7 to 23 carbon atoms, and specific examples
thereof include caprylic acid, pelargonic acid,
capric acid, undecanoic acid, lauric acid,
tridecanoic acid, myristic acid, pentadecanoic acid,
palmitic acid, margaric acid, stearic acid, oleic
acid, elaidic acid, linoleic acid, linolenic acid,
stearolic acid, ricinoleic acid, ricinoelaidic acid,
nonadecanoic acid, arachidic acid, heneicosanoic
acid, behenic acid, brassidic acid, erucic acid,
tricosanoic acid, tetracosanoic acid, coconut oil
fatty acid, beef tallow fatty acid, palm oil fatty
acid, tall oil fatty acid, rape oil fatty acid, and
fish oil fatty acid. Among nonionic surfactants
(B), those having an alkyl or alkenyl group,
particularly an alkyl group, represented by R of 11
to 23 carbon atoms are preferred.

<Nonionic surfactant (C): a compound represented by
the formula: $RO(AO)_nH$>

Wherein R represents an alkyl or alkenyl group
having 8 to 24 carbon atoms; AO represents an
oxyalkylene group having 2 to 4 carbon atoms; and n

is an integer of 1 or more.

When the carbon atom number of the alkyl or
alkenyl group in the definition of R is 8 to 24, the
nonionic surfactant (C) exhibits an excellent
ability for stripping ink from cellulose to thereby
provide reclaimed pulp having a high whiteness and
an excellent appearance.

The nonionic surfactant (C) is prepared by
adding an alkylene oxide to a monohydric alcohol by
a conventional methods. The alkylene oxide is added
to a monohydric alcohol in an amount, on the
average, of 5 to 300 moles, preferably 7 to 150
moles, per mole of the monohydric alcohol. That is,
the nonionic surfactant (C) is generally a reaction
product mixture comprising compounds each
represented by the above-mentioned formula:
$RO(AO)_nH$. Examples of the alkylene oxide include
those mentioned in the above description relating to
the nonionic surfactant (A). It is preferred to use
ethylene oxide and propylene oxide in a molar ratio
of ethylene oxide to propylene oxide of 1/5 to 5/1
in the production of the nonionic surfactant (C).

Examples of the monohydric alcohols to be used
for producing the nonionic surfactant (C) include
those having an alkyl or alkenyl moiety of 8 to 24
carbon atoms, and those having an alkylphenyl moiety
wherein the alkyl moiety having 6 to 14 carbon

18

atoms, and specific examples thereof include those
mentioned in the foregoing description relating to
the nonionic surfactant (A). Among nonionic
surfactants (C), those having an alkyl or alkenyl
group, particularly an alkyl group, represented by R
of 14 to 24 carbon atoms are preferred.

<Nonionic surfactant (D): A reaction product
obtained by adding an alkylene oxide to a polyvalent
carboxylic acid or an acid anhydride thereof, or a
reaction product obtained by adding an alkylne oxide
to a mixture of a polyvalent (or polybasic)
carboxylic acid or an acid anhydride thereof, and an
alcohol>

Examples of the polyvalent (or polybasic)
carboxylic acid and acid anhydride thereof as a
starting material of the nonionic surfactant (D)
include oxalic acid, malonic acid, succinic acid,
methylsuccinic acid, maleic acid, glutaric acid,
adipic acid, phthalic acid, fumaric acid, itaconic
acid, malic acid, tartaric acid, maleinized (or
maleated) oleic acid, citric acid, percitric acid,
trimellitic acid, butanetetracarboxylic acid,
pyromellitic acid, tetradecanehexacarboxylic acid,
maleic anhydride, succinic anhydride, oxalic
anhydride, itaconic anhydride, glutaric anhydride,
phthalic anhydride, trimellitic anhydride,
pyromellitic anhydride, and stearylsuccinic

anhydride.

Dimer acids and polymer acids of higher fatty
acids having 14 to 22 carbon atoms are also included
in the scope of the polybasic carboxylic acids.
Dimer acids and polymer acids herein can be
synthesized by a method wherein a monoolefinic
carboxylic acid or a diolefinic carboxylic acid,
such as an unsaturated fatty acid monomer, e.g.,
oleic acid, linoleic acid, and linolenic acid, is
subjected to thermal polymerization such as a Diels-
Alder reaction, or another method. The polymer acid
herein is a polycarboxylic acid having 3 or more
carboxyl groups in a molecule and does not includes
a dimer acid. The dimer acid or polymer acid used
herein may be a mixture thereof with an unreacted
monomer acid. That is, it is not concerned that an
unreacted monomer acid is present as far as the
effects of the present invention are not failed.

Examples of the alcohol as a starting material
of the nonionic surfactant (D) include monohydric
and polyhydric alcohols, and specific examples
thereof include those mentioned in the foregoing
description relating to the nonionic surfactant (A).

In the production of the nonionic surfactant
(D) with a polybasic carboxylic acid or an acid
anhydride thereof (I) and an alcohol (II), the
compounds (I) and (II) are preferably used in a

molar ratio of (I) to (II) of 1/0.02 to 5,
particularly 1/0.1 to 3. When the molar ratio falls
within this range, the above-mentioned nonionic
surfactant (D) can efficiently collect fine ink
drops and the collected ink drops are effectively
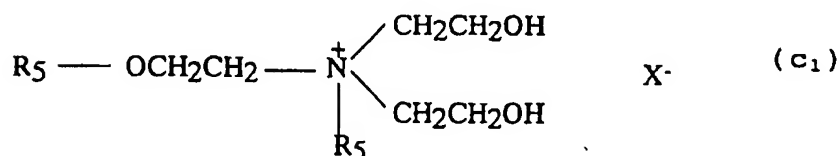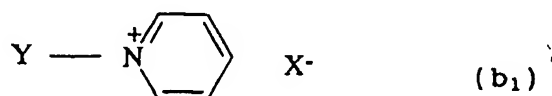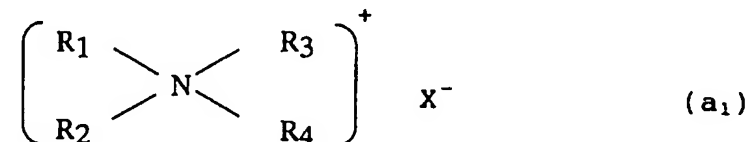removed out in flotation.

On the other hand, higher fatty acids or salts
thereof are suitably used as the anionic surfactant.
Quaternary ammonium salts are used as the cationic
surfactant, mono(long-chain alkyl) quaternary
ammonium salts are particularly preferred.

.The surfactant may be added in any step of the
deinking process. However, it is usually added in
the pulping step. The addition amount thereof is
not particularly restricted. Any known deinking
agent other than the foregoing nonionic surfactants
(A) to (D) may of course be used in combination
therewith.

In the deinking process of the present
invention, a cationic compound, an amine, an acid
salt of an amine, or an amphoteric compound is
preferably made present in the system in flotation.
Additional use of such a compound can further
improve the bulkiness of pulp sheets.

Examples of the cationic compounds include mono
(long-chain alkyl) quaternary ammonium salts, di
(long-chain alkyl) quaternary ammonium salts,

pyridinium salts having a substituent group on the
nitrogen atom thereof, and cationic polymers. Among
cationic compounds, particularly preferred are ones
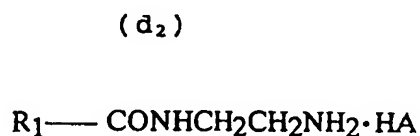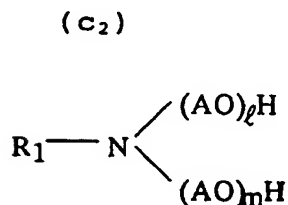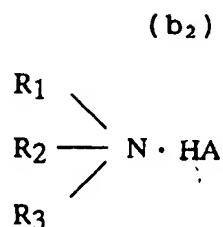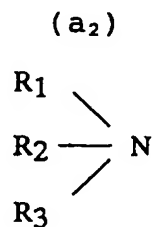represented by the following formulae (a_1) to (c_1):

$$\left[\begin{array}{c} R_1 \\ R_2 \end{array} \right> N \left< \begin{array}{c} R_3 \\ R_4 \end{array} \right]^+ \quad X^- \qquad (a_1)$$

$$Y - \overset{+}{N} \!\!\!\diagup\!\!\!\bigcirc \quad X^- \qquad (b_1)$$

$$R_5 - OCH_2CH_2 - \overset{+}{\underset{\underset{R_5}{|}}{N}} \overset{\diagup CH_2CH_2OH}{\underset{\diagdown CH_2CH_2OH}{}} \quad X^- \qquad (c_1)$$

in the formulae (a_1) to (c_1), R_1 and R_2 may be the
same or different from each other and each
represents an alkyl, alkenyl or β-hydroxyalkyl group
having 10 to 24 carbon atoms; R_3 and R_4 may be the
same or different from one each other and each
represents an alkyl or hydroxyalkyl group having 1
to 8 carbon atoms, a benzyl group, or a group
represented by the formula: $-(AO)_n-Z$ (wherein AO
represented by an oxyalkylene group having 2 to 4
carbon atoms; Z represents a hydrogen atom or an
acyl group; and n is an integer of from 1 to 50); R_5
represents an alkyl, alkenyl or β-hydroxyalkyl group

having 8 to 36 carbon atoms; X⁻ represents a counter

ion; and Y represents an alkyl, alkenyl or

β-hydroxyalkyl group having 8 to 36 carbon atoms, a

group represented by the formula: R_5COOCH_2- (wherein

R_5 is as defined above), a group represented by the

formula: $R_5CONHCH_2-$ (wherein R_5 is as defined above)

or a group represented by the formula:
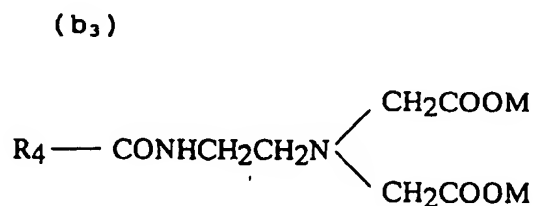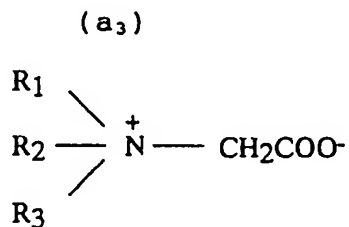
R_5OCH_2- (wherein R_5 is as defined above).

Examples of the amines and the acid salts of

the amines include primary amines, secondary amines,

tertiary amines, cyclic amines, imidazoles,

imidazolines, inorganic acid salts of these amines,

organic acid salts of these amines, and polymers

containing amino groups. Amines or acid salts of

amines represented by the following formulae (a_2) to

(e_2) are preferred as the amine or the acid salt of

the amine.

(a_2)

$$\begin{array}{c} R_1 \\ R_2 \end{array} \!\!\!\! \diagdown \diagup \!\!\!\! N \\ R_3$$

(b_2)

$$\begin{array}{c} R_1 \\ R_2 \end{array} \!\!\!\! \diagdown \diagup \!\!\!\! N \cdot HA \\ R_3$$

(c_2)

$$R_1 - N \underset{\diagdown (AO)_m H}{\overset{\diagup (AO)_\ell H}{}}$$

(d_2)

$$R_1 - CONHCH_2CH_2NH_2 \cdot HA$$

(e₂)

$$R_1 \!\!-\!\! COOCH_2CH_2N \!\!<\!\! \genfrac{}{}{0pt}{}{CH_2CH_2OH}{CH_2CH_2OH} \cdot HA$$
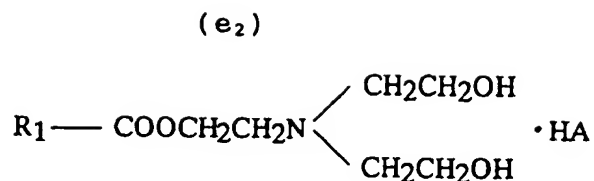
in the formulae (a₂) to (e₂), R₁ represents an alkyl,
alkenyl or β-hydroxyalkyl group having 8 to 36
carbon atoms; R₂ and R₃ may be the same or different
from each other and each represents a hydrogen atom,
an alkyl group having 1 to 24 carbon atoms or an
alkenyl group having 2 to 24 carbon atoms; HA
represents an inorganic or organic acid; AO
represents an oxyalkylene group having 2 to 4 carbon
atoms; and ℓ and m are each zero or a positive
integer with the proviso that ℓ plus m is an integer
of 1 to 300.

Examples of the amphoteric compounds include
betaines, amine oxides, phospholipids, proteins, and
amphoteric polymers. Amphoteric compounds
represented by the following formulae (a₃) to (d₃)
are particularly preferred as the amphoteric
compound.

(a₃)   (b₃)

$$R_2 \!\!-\!\! \overset{+}{N} \!\!-\!\! CH_2COO^-$$
with R₁ and R₃ on the nitrogen

$$R_4 \!\!-\!\! CONHCH_2CH_2N \!\!<\!\! \genfrac{}{}{0pt}{}{CH_2COOM}{CH_2COOM}$$

24

$$(c_3) \qquad\qquad (d_3)$$

$$R_4 - NHCH_2CH_2COOM$$

$$\begin{matrix} R_1 \\ R_2 - N^+ \\ R_3 \\ \qquad CHCOO^- \\ \qquad CH_2COOH \end{matrix}$$
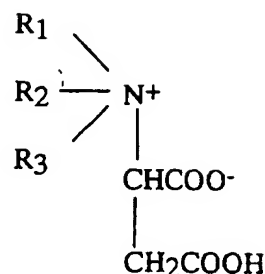
in the formulae (a_3) to (d_3), R_1, R_2 and R_3 may be the same or different from one another and each represents an alkyl group having 1 to 24 carbon atoms or an alkenyl group having 2 to 24 carbon atoms; R_4 represents an alkyl, alkenyl or β-hydroxyalkyl group having 8 to 36 carbon atoms; and M represents a hydrogen atom, an alkali metal atom, 1/2 mole of an alkaline earth metal atom or an ammonium group.

At least one member selected from the group consisting of cationic compounds, amines, acid salts of amines, and amphoteric compounds is used in an amount of 0.001 to 5.0 % by weight, preferably 0.01 to 1.0 % by weight, based on the weight of wastepaper (i.e., the absoluted dry weight of wastepaper) in flotation. When the above-mentioned at least one member selected is present in the system, i.e., in the slurry, in flotation in such an amount as described above, ink can be selectively removed from the system.

The deinking process of the present invention,

which is characterized by the aforementioned control
of the interfacial potentials of ink particles and
pulp in the flotation step, and comprises at least
the step of stripping ink from wastepaper and the
step of removing the stripped ink from the flotation
system. Other steps can be carried out in
accordance with the conventional deinking methods.
That is, the deinking process may comprise, as the
main steps, a disintegration (or pulping) step, an
aging step, (if necessary, a kneading step), a
flotation step and a washing step. The deinking
process may further comprise other step(s), if
necessary. The respective steps may be carried out
two or more times.

Examples

     The following Examples will more specifically
illustrate the present invention, though they should
not be construed as limiting the scope of the
present invention.

<Compound to be added>

     Amines, acid salts of amines, cationic
compounds and amphoteric compounds additionally
used, if necessary, in the following Examples are
listed in the following Tables 1 to 12.

26

Table 1

Formula	Compd. No.	Structure in the Formula		
		R_1	R_2	R_3
R_1 $\backslash$ $R_2 - N$ $/$ R_3	I-a-1	12	H	H
	I-a-2	12	1	1
	I-a-3	18	18	1
	I-a-4	22	1	H

Table 2

Formula	Compd. No.	Structure in the Formula			
		R_1	R_2	R_3	HA
R_1 $\backslash$ $R_2 - N \cdot HA$ $/$ R_3	I-b-1	12	H	H	CH_3COOH

Table 3

Formula	Compd. No.	Structure in the Formula		
		R_1	$\ell + m$	AO
				EO/PO
$R_1N$$\diagup$(AO)$_\ell$H$\diagdown$(AO)$_\ell$H	1-c-1	12	4	100/0

Table 4

Formula	Compd. No.	Structure in the Formula	
		R_1	HA
$R_1CONHCH_2CH_2NH_2 \cdot HA$	I-d-1	22	1/2 H_2SO_4

Table 5

Formula	Compd. No.	Structure in the Formula	
		R_1	HA
$R_1COOCH_2CH_2N$ ⟨ CH_2CH_2OH / CH_2CH_2OH ·HA	I-e-1	18	HCl

Table 6

Formula	Compd. No.	Structure in the Formula		
		R_1	R_2	R_3
R_1 \ ⊕ / $R_2-NCH_2COO^⊖$ / R_3	II-a-1	12	1	1

Table 7

Formula	Compd. No.	Structure in the Formula	
		R_4	M
$R_4CONHCH_2CH_2N$ ⟨ CH_2COOM / CH_2COOM	II-b-1	18	Na

Table 8

Formula	Compd. No.	Structure in the Formula	
		R_4	M
$R_4NHCH_2CH_2COOM$	II-c-1	18	Na

Table 9

Formula	Compd. No.	Structure in the Formula		
		R_1	R_2	R_3
R_1 \ ⊕ R_2-N / R_3 \ $CHCOO^⊖$ / CH_2COOH	II-d-1	12	1	1

28

Table 10

Formula	Compd. No.	Structure in the Formula				
		R_1	R_2	R_3	R_4	X^-
$\left[\begin{smallmatrix} R_1 \\ R_2 \end{smallmatrix} > N < \begin{smallmatrix} R_3 \\ R_4 \end{smallmatrix} \right]^+ X^-$	III-a-1	12	18	1	1	CH_3COO^-
	III-a-2	18	18	2	2	Cl^-

Table 11

Formula	Compd. No.	Structure in the Formula	
		Y	X^-
$Y - N^+ \langle \text{pyridinium} \rangle X^\ominus$	III-b-1	$C_{18}H_{37}OCH_2-$	Br^-

Table 12

Formula	Compd. No.	Structure in the Formula		
		R_{6a}	R_{6b}	X^-
$R_{6b}-O-CH_2CH_2\overset{\oplus}{N} \underset{\underset{X^\ominus}{\overset{\mid}{R_{6a}}}}{\langle} \begin{smallmatrix} CH_2CH_2OH \\ CH_2CH_2OH \end{smallmatrix}$	III-c-1	18	18 F1	Cl^-

Example 1

Wastepapers (newspapers/leaflets : 70/30) as
the starting material which were recovered in a city
were cut into 4 cm × 4 cm pieces. A given amount
thereof was fed into a bench disintegrator. Then,
warm water, 1 % by weight (based on the starting
material) of sodium hydroxide, 3 % by weight (based
on the starting material) of sodium silicate, 3 % by
weight (based on the starting material) of a 30%
aqueous solution of hydrogen peroxide and 0.2 % by
weight (based on the starting material) of a block

29

adduct of stearyl alcohol with 10 moles of EO and 10

moles of PO (in terms of the average number of moles

of addition) as a deinking agent were added thereto,

and the resultant mixture having a pulp

concentration of 5% by weight was disintegrated at

40°C for 10 minutes. The resulting pulp slurry was

aged at 40°C for 60 minutes, and then warm water was

added for dilution to a pulp concentration of 1%.

The pulp slurry was adjusted with respect to the pH

by using sulfuric acid to control the interfacial

potentials (ζ potentials) of ink and pulp as shown

in Table 13, at which stage the compound to be added

as shown in Table 13, if to be added, was further

added. The pulp slurry was subject to flotation at

40°C for 10 minutes. The amount of the added

compound of Table 13 was based on the absolute dry

weight of wastepaper, while the ζ potentials of

Table 13 scarcely varied throughout the flotation

step. The ζ potential was measured with the System

3000 manufactured by Pen Kem Co. according to the

aforementioned procedure. After the flotation

treatment, pulp slurry was treated on a TAPPI

standard sheet machine to give pulp sheet. The pulp

sheet thus obtained were pressed under a pressure of

5 kgf/cm^2 and then air-dried to measure the

bulkiness thereof. The results are shown in Table

13.

In this Example, the bulkiness was expressed in terms of bulk density. The bulk density was calculated from the thickness of a 25 cm × 25 cm pulp sheet, measured with a micrometer, and the weight thereof according to the following formula:

bulk density $[g/cm^3]$ =

(weight of sheet)/(25 × 25 × sheet thickness)

It is believed that the pulp sheet is bulkier and better in printability and the like as the bulk density thereof is lowered, while a difference of 0.02 in bulk density can be well recognized as a significant difference.

Table 13

Test No.	pH	ζ potential (mV)		Compd. to be added		Bulk density
		ink	pulp	Symbol	Concn. (%)	
1	10.0	-35.8	-16.4	-	-	0.56
2	9.0	-34.8	-16.1	-	-	0.56
3	7.5	-29.4	- 5.5	-	-	0.54
4	7.0	-28.5	- 3.3	-	-	0.53
5	6.0	-26.0	- 3.0	-	-	0.53
6	5.0	-12.0	- 1.8	-	-	0.54
7	4.0	- 4.0	- 0.2	-	-	0.57
8	10.0	-35.8	-16.4	I-a-1	0.05	0.56
9	7.0	-28.5	- 3.3	I-a-1	0.05	0.51
10	7.0	-28.5	- 3.3	I-a-3	0.2	0.52
11	7.0	-28.5	- 3.3	II-c-1	0.2	0.52
12	7.0	-28.5	- 3.3	I-b-1	0.25	0.51
13	7.0	-28.5	- 3.3	III-a-2	0.25	0.51
14	7.5	-29.4	- 5.5	I-d-1	0.2	0.52
15	7.5	-29.4	- 5.5	II-d-1	0.2	0.52
16	7.5	-29.4	- 5.5	III-b-1	0.2	0.52
17	5.0	-12.0	- 1.8	I-a-2	0.2	0.53

Example 2

Wastepapers (newspapers/leaflets : 70/30) as
the starting material which were recovered in a city
were cut into 4 cm × 4 cm pieces. A given amount
thereof was fed into a bench disintegrator. Then,
warm water, 1 % by weight (based on the starting
material) of sodium hydroxide, 3 % by weight (based
on the starting material) of sodium silicate, 3 % by
weight (based on the starting material) of a 30%
aqueous solution of hydrogen peroxide and 0.2 % by
weight (based on the starting material) of a random

adduct of stearic acid with 15 moles of EO and 10
moles of PO (in terms of the average number of moles
of addition) as a deinking agent were added thereto,
and the resultant mixture having a pulp
concentration of 4% by weight was disintegrated at
40°C for 10 minutes. The resulting pulp slurry was
aged at 40°C for 60 minutes, and then warm water was
added for dilution to a pulp concentration of 1%.
The pulp slurry was adjusted with respect to the pH
by using sulfuric acid to control the interfacial
potentials (ζ potentials) of ink and pulp as shown
in Table 14, at which stage the compound to be added
as shown in Table 14, if to be added, was further
added. The pulp slurry was subject to flotation at
40°C for 10 minutes. The amount of the added
compound of Table 14 was based on the absolute dry
weight of wastepaper, while the ζ potentials of
Table 14 scarcely varied throughout the flotation
step. After the flotation treatment, pulp slurry
was treated on a TAPPI standard sheet machine to
give pulp sheet. The pulp sheet thus obtained were
pressed under a pressure of 5 kgf/cm^2 and then
air-dried to measure the bulkiness thereof. The
results are shown in Table 14. In this Example, the
ζ potential and the bulk density were measured
respectively in the same manner as in Example 1.

Table 14

Test No.	pH	ζ potential (mV)		Compd. to be added		Bulk density
		ink	pulp	Symbol	Concn. (%)	
18	10.0	-30.4	-15.4	-	-	0.56
19	9.0	-30.0	-15.2	-	-	0.55
20	7.5	-27.2	- 5.0	-	-	0.53
21	7.0	-27.0	- 3.0	-	-	0.53
22	6.0	-24.5	- 3.0	-	-	0.53
23	5.0	-10.8	- 0.8	-	-	0.53
24	7.0	-27.0	- 3.0	I-a-4	0.05	0.51
25	7.0	-27.0	- 3.0	I-b-1	0.2	0.50
26	7.0	-27.0	- 3.0	II-a-1	0.2	0.52
27	7.0	-27.0	- 3.0	I-c-1	0.25	0.52
28	7.0	-27.0	- 3.0	III-a-1	0.25	0.51
29	7.5	-27.2	- 5.0	I-e-1	0.2	0.53
30	7.5	-27.2	- 5.0	II-b-1	0.2	0.52
31	7.5	-27.2	- 5.0	III-c-1	0.2	0.53

Example 3

Wastepapers (newspapers/leaflets : 70/30) as
the starting material which were recovered in a city
were cut into 4 cm × 4 cm pieces. A given amount
thereof was fed into a bench disintegrator. Then,
warm water, 1 % by weight (based on the starting
material) of sodium hydroxide, 3 % by weight (based
on the starting material) of sodium silicate, 3 % by
weight (based on the starting material) of a 30%
aqueous solution of hydrogen peroxide and 0.2 % by
weight (based on the starting material) of a random
adduct of stearyl alcohol with 15 moles of EO and 15
moles of PO (in terms of the average number of moles

of addition) as a deinking agent were added thereto,
and the resultant mixture having a pulp
concentration of 5% by weight was disintegrated at
40°C for 10 minutes. The resulting pulp slurry was
aged at 40°C for 60 minutes, and then warm water was
added for dilution to a pulp concentration of 1%. As
shown in Table 15, the type and concentration (based
on the starting material) of an inorganic salt were
adjusted to control the interfacial potentials (ζ
potentials) of ink and pulp. The pulp slurry was
subject to flotation at 40°C for 10 minutes. The ζ
potentials at the time of completion of flotation
were substantially the same as those at the time of
control thereof. After the flotation treatment, pulp
slurry was treated on a TAPPI standard sheet
machine to give pulp sheet. The pulp sheet thus
obtained were pressed under a pressure of 5 kgf/cm^2
and then air-dried to measure the bulkiness thereof.
The results are shown in Table 15. In this Example,
the ζ potential and the bulk density were measured
respectively in the same manner as in Example 1.

Table 15

Test No.	ζ potential (mV)		Inorg. salt		Bulk density
	ink	pulp	Compd.	Concn. (%)	
32	-35.4	-16.2	-	-	0.57
33	-34.8	-13.4	NaCl	0.2	0.54
34	-27.2	- 6.2	NaCl	1.0	0.52
35	-26.1	- 4.1	NaCl	5.0	0.52
36	-27.0	- 4.0	CaCl₂	2.0	0.53
37	-24.5	- 3.0	CaCl₂	3.0	0.52

Example 4

Wastepapers (newspapers/leaflets : 70/30) as
the starting material which were recovered in a city
were cut into 4 cm × 4 cm pieces. A given amount
thereof was fed into a bench disintegrator. Then,
warm water, 1 % by weight (based on the starting
material) of sodium hydroxide, 3 % by weight (based
on the starting material) of sodium silicate, 3 % by
weight (based on the starting material) of a 30%
aqueous solution of hydrogen peroxide and 0.2 % by
weight (based on the starting material) of a block
adduct of beef tallow/glycerol (1:1) with 70 moles
of EO and 10 moles of PO (in terms of the average
number of moles of addition) as a deinking agent
were added thereto, and the resultant mixture having
a pulp concentration of 5% by weight was
disintegrated at 40°C for 10 minutes. The resulting
pulp slurry was aged at 40°C for 60 minutes, and
then warm water was added for dilution to a pulp

concentration of 1%. As shown in Table 16, the type
and concentration (based on the starting material)
of an inorganic salt were adjusted to control the
interfacial potentials (ζ potentials) of ink and
pulp. The pulp slurry was subject to flotation at
40°C for 10 minutes. The ζ potentials at the time of
completion of flotation were substantially the same
as those at the time of control thereof. After the
flotation treatment, pulp slurry was treated on a
TAPPI standard sheet machine to give pulp sheet. The
pulp sheet thus obtained were pressed under a
pressure of 5 kgf/cm^2 and then air-dried to measure
the bulkiness thereof. The results are shown in
Table 16. In this Example, the ζ potential and the
bulk density were measured respectively in the same
manner as in Example 1.

Table 16

Test No.	ζ potential (mV)		Inorg. salt		Bulk density
	ink	pulp	Compd.	Concn. (%)	
38	-34.8	-16.6	-	-	0.57
39	-32.8	-11.4	Na$_2$SO$_4$	0.2	0.55
40	-26.7	- 5.0	Na$_2$SO$_4$	1.0	0.52
41	-25.1	- 3.6	Na$_2$SO$_4$	3.0	0.51
42	-25.0	- 3.8	NaNO$_3$	2.0	0.53
43	-24.5	- 3.0	KCl	2.0	0.52

Example 5

   Wastepapers (newspapers/leaflets : 70/30) as

the starting material which were recovered in a city
were cut into 4 cm x 4 cm pieces. A given amount
thereof was fed into a bench disintegrator. Then,
warm water, 1 % by weight (based on the starting
material) of sodium hydroxide, 3 % by weight (based
on the starting material) of sodium silicate, 3 % by
weight (based on the starting material) of a 30%
aqueous solution of hydrogen peroxide and 0.2 % by
weight (based on the starting material) of a block
adduct of stearyl alcohol with 10 moles of EO and 10
moles of PO (in terms of the average number of moles
of addition) as a deinking agent were added thereto,
and the resultant mixture having a pulp
concentration of 5% by weight was disintegrated at
40°C for 10 minutes. The resulting pulp slurry was
aged at 40°C for 60 minutes, and then warm water was
added for dilution to a pulp concentration of 1%. As
shown in Table 17, the type and concentration (based
on the starting material) of an inorganic salt were
adjusted to control the interfacial potentials (ζ
potentials) of ink and pulp, at which stage the
compound to be added as shown in Table 17, if to be
added, was further added. The pulp slurry was
subject to flotation at 40°C for 10 minutes. The
amount of the added compound of Table 17 was based
on the absolute dry weight of wastepaper, while the
ζ potentials of Table 17 scarcely varied throughout

the flotation step. After the flotation treatment,
pulp slurry was treated on a TAPPI standard sheet
machine to give pulp sheet. The pulp sheet thus
obtained were pressed under a pressure of 5 kgf/cm²
and then air-dried to measure the bulkiness thereof.
The results are shown in Table 17. In this Example,
the ζ potential and the bulk density were measured
respectively in the same manner as in Example 1.

Table 17

Test No.	ζ potential (mV)		Inorg. salt		Compd. to be added		Bulk density
	ink	pulp	Compd.	Concn. (%)	Symbol	Concn. (%)	
44	-34.8	-16.6	-	-	-	-	0.57
45	-28.8	- 5.8	MgCl₂	3.0	-	-	0.55
46	-28.8	- 5.8	MgCl₂	3.0	I-b-1	0.3	0.52
47	-27.1	- 5.6	Na₂SO₄	3.0	-	-	0.51
48	-25.0	- 5.6	Na₂SO₄	3.0	II-a-1	0.3	0.53

Example 6

    Wastepapers (newspapers/leaflets : 70/30) as
the starting material which were recovered in a city
were cut into 4 cm × 4 cm pieces. A given amount
thereof was fed into a bench disintegrator. Then,
warm water, 1 % by weight (based on the starting
material) of sodium hydroxide, 3 % by weight (based
on the starting material) of sodium silicate, 3 % by
weight (based on the starting material) of a 30%
aqueous solution of hydrogen peroxide and 0.5 % by
weight (based on the starting material) of stearic

acid as a deinking agent were added thereto, and the

resultant mixture having a pulp concentration of 5%

by weight was disintegrated at 40°C for 10 minutes.

The resulting pulp slurry was aged at 40°C for 60

minutes, and then warm water was added for dilution

to a pulp concentration of 1%. The pulp slurry was

adjusted with respect to the pH by using sulfuric

acid to control the interfacial potentials (ζ

potentials) of ink and pulp as shown in Table 18, at

which stage the compound to be added as shown in

Table 18, if to be added, was further added. The

pulp slurry was subject to flotation at 40°C for 10

minutes. The amount of the added compound of Table

18 was based on the absolute dry weight of

wastepaper, while the ζ potentials of Table 18

scarcely varied throughout the flotation step.

After the flotation treatment, pulp slurry was

treated on a TAPPI standard sheet machine to give

pulp sheet. The pulp sheet thus obtained were

pressed under a pressure of 5 kgf/cm^2 and then

air-dried to measure the bulkiness thereof. The

results are shown in Table 18. In this Example, the

ζ potential and the bulk density were measured

respectively in the same manner as in Example 1.

Table 18

Test No.	pH	ζ potential (mV)		Compd. to be added		Bulk density
		ink	pulp	Symbol	Concn. (%)	
49	10.0	-38.2	-17.4	-	-	0.57
50	7.0	-31.4	- 9.2	-	-	0.55
51	7.0	-28.5	- 3.3	I-a-1	0.5	0.54

Example 7

Wastepapers (newspapers/leaflets : 70/30) as the starting material which were recovered in a city were cut into 4 cm × 4 cm pieces. A given amount thereof was fed into a bench disintegrator. Then, warm water, 1 % by weight (based on the starting material) of sodium hydroxide, 3 % by weight (based on the starting material) of sodium silicate, 3 % by weight (based on the starting material) of a 30% aqueous solution of hydrogen peroxide and 0.5 % by weight (based on the starting material) of cetyltrimethylammonium chloride as a deinking agent were added thereto, and the resultant mixture having a pulp concentration of 5% by weight was disintegrated at 40°C for 10 minutes. The resulting pulp slurry was aged at 40°C for 60 minutes, and then warm water was added for dilution to a pulp concentration of 1%. The pulp slurry was adjusted with respect to the pH by using sulfuric acid to control the interfacial potentials (ζ potentials) of ink and pulp as shown in Table 19, at which stage the compound to be added as shown in Table 19, if to

41

be added, was further added. The pulp slurry was
subject to flotation at 40°C for 10 minutes. The
amount of the added compound of Table 19 was based
on the absolute dry weight of wastepaper, while the
ζ potentials of Table 19 scarcely varied throughout
the flotation step. After the flotation treatment,
pulp slurry was treated on a TAPPI standard sheet
machine to give pulp sheet. The pulp sheet thus
obtained were pressed under a pressure of 5 kgf/cm²
and then air-dried to measure the bulkiness thereof.
The results are shown in Table 19. In this Example,
the ζ potential and the bulk density were measured
respectively in the same manner as in Example 1.

<div align="center">Table 19</div>

Test No.	pH	ζ potential (mV)		Compd. to be added		Bulk density
		ink	pulp	Symbol	Concn. (%)	
52	10.0	-20.9	-12.8	-	-	0.56
53	7.0	-19.4	- 0.8	-	-	0.53
54	7.0	-15.6	- 0.4	I-a-1	0.20	0.53

Example 8

    Wastepapers (newspapers/leaflets : 70/30) as
the starting material which were recovered in a city
were cut into 4 cm × 4 cm pieces. A given amount
thereof was fed into a bench disintegrator. Then,
warm water, 1 % by weight (based on the starting
material) of sodium hydroxide, 3 % by weight (based
on the starting material) of sodium silicate, 3 % by

weight (based on the starting material) of a 30%
aqueous solution of hydrogen peroxide and 0.2 % by
weight (based on the starting material) of a block
adduct of stearyl alcohol with 10 moles of EO and 10
moles of PO as a deinking agent were added thereto,
and the resultant mixture having a pulp
concentration of 15% by weight was disintegrated at
40°C for 10 minutes. The resulting pulp slurry was
aged at 50°C for 60 minutes, and then warm water was
added for dilution to a pulp concentration of 1%.
The pulp slurry was adjusted with respect to the pH
by using sulfuric acid to control the interfacial
potentials (ζ potentials) of ink and pulp as shown
in Table 20, at which stage the compound to be added
as shown in Table 20, if to be added, was further
added. The pulp slurry was subject to flotation at
40°C for 10 minutes. The amount of the added
compound of Table 20 was based on the absolute dry
weight of wastepaper, while the ζ potentials of
Table 20 scarcely varied throughout the flotation
step. After the flotation treatment, pulp slurry
was treated on a TAPPI standard sheet machine to
give pulp sheet. The pulp sheet thus obtained were
pressed under a pressure of 5 kgf/cm^2 and then
air-dried to measure the bulkiness thereof. The
results are shown in Table 20. In this Example, the
ζ potential and the bulk density were measured

respectively in the same manner as in Example 1.

Table 20

Test No.	pH	ζ potential (mV)		Compd. to be added		Bulk density
		ink	pulp	Symbol	Concn. (%)	
55	10.0	-61.2	-35.2	-	-	0.58
56	9.0	-60.4	-17.5	-	-	0.58
57	7.5	-59.9	-14.9	-	-	0.56
58	7.0	-56.2	-14.6	-	-	0.55
59	6.0	-48.2	-14.5	-	-	0.55
60	7.5	-59.9	-14.9	I-a-1	0.20	0.54
61	7.0	-56.2	-14.6	I-a-1	0.20	0.54
62	6.0	-48.2	-14.5	I-a-1	0.05	0.54

Claims

1. A deinking process comprising at least the step
of stripping ink from a pulp slurry formed from
wastepaper as the starting material, wherein at
least one surfactant is used for ink stripping, and
the step of removing the stripped ink by flotation,
characterized by controlling before or in the
flotation step the interfacial potential (ζ
potential) of ink particles in said pulp slurry
containing the stripped ink to be in the range of -5
mV to -60 mV and that of pulp in said pulp slurry
containing the stripped ink to be in the range of
-15 mV to +15 mV with a difference of at least 10 mV
between the interfacial potential (ζ potential) of
said ink particles and said pulp.

2. The deinking process as claimed in Claim 1,
characterized by controlling the interfacial
potential (ζ potential) of said ink particles to be
in the range of -10 mV to -40 mV and that of said
pulp to be in the range of -5 mV to +5 mV before or
in said flotation step.

3. The deinking process as claimed in Claim 1 or 2,
wherein the ζ potentials of said ink and said pulp
are controlled by pH adjustment before or in the
flotation step.

4. The deinking process as claimed in Claim 1 or 2,
wherein the ζ potentials of said ink and said pulp

are controlled by adding an inorganic electrolyte

before or in the flotation step.

5. The deinking process as claimed in any one of

Claims 1 to 4, wherein at least a part of the

flotation step is effected in the presence of at

least one member selected from the group consisting

of amine compounds, ammonium salts, cationic

compounds, and amphoteric compounds.

6. A deinking process at least comprising the step

of stripping ink from wastepaper as the starting

material and the step of removing the stripped ink

by the flotation method, characterized by continuing

the deinking treatment when the interfacial

potential (ζ potential) of ink particles is in the

range of -5 mV to -60 mV and that of pulp is in the

range of -15 mV to +15 mV with a difference of at

least 10 mV in interfacial potential (ζ potential)

between said ink particles and said pulp as a result

of measurement of the interfacial potentials of said

ink particles and said pulp in the flotation step.

7. A method for controlling the deinking

performance in a deinking process comprising at

least the step of stripping ink from a pulp slurry

formed from wastepaper as the starting material, and

the step of removing the stripped ink by flotation,

characterized by measuring before or in the

flotation step the interfacial potential (ζ

46

potential) of ink particles and pulp in said pulp
slurry containing the stripped ink and adjusting the
interfacial potential (ζ potential) of the ink
particles to the range of -5 mV to -60 mV and the
interfacial potential (ζ potential) of pulp to -15
mV to +15 mV with a difference of at least 10 mV in
interfacial potential (ζ potential) between said ink
particles and said pulp.

INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6   D21C5/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6   D21C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 492 507 A (KAO CORP) 1 July 1992 see page 5, line 12 - line 25 ---	1,2,5-7
A	EP 0 447 672 A (CALL HANS PETER) 25 September 1991 see column 3, line 21 - column 4, line 18 --- -/--	1,4-7

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

* Special categories of cited documents :

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Date of the actual completion of the international search	Date of mailing of the international search report
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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